IS 11626 (2005): Recommended practice for ultrasonic testing and acceptance for forging quality steel blooms [MTD 21: Non-Destructive Testing]

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भारतीय मानक

पराश्रव्य परीक्षण की अनुशंसित रीति और सादे कार्बन एवं निम्न मिश्रधातु गढाई इस्पात ब्लूम की स्वीकार्यता

(पहला पुनरीक्षण)

Indian Standard

RECOMMENDED PRACTICE FOR ULTRASONIC TESTING AND ACCEPTANCE FOR PLAIN CARBON AND LOW ALLOY FORGING QUALITY STEEL BLOOMS

(First Revision)

ICS 77.040.20.77.140.50

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2005

Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Non-destructive Testing Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1986. It has now been revised in the light of the experience gained since its last publication. When applying ultrasonic techniques, it is essential that the operators are fully conversant with the characteristics of the equipment to be used and have a fair knowledge about the method of manufacture of the item under test and the type, position and probable distribution of the defects likely to be present.

In this revision, following modifications have been carried out:

a) Scope has been modified, and

b) Clause on calibration of apparatus has been modified.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounding off value should be the same as that of the specified value in this standard.

Indian Standard

RECOMMENDED PRACTICE FOR ULTRASONIC TESTING AND ACCEPTANCE FOR PLAIN CARBON AND LOW ALLOY FORGING QUALITY STEEL BLOOMS

(First Revision)

1 SCOPE

1.1 This standard describes for carrying out ultrasonic examination using straight beam, pulse-echo contact technique of plain carbon and low alloy forging quality blooms. It is applicable for blooms of sizes up to 300 mm × 300 mm from ingot route and 200 mm × 200 mm from continuous casting route.

1.2 In case of bloom rolled from the continuous casting product, the reduction ratio between the rolled blooms and cast product shall not be less than 9.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

IS No.	*Title*
2417 : 2003	Glossary of terms used in ultrasonic non-destructive testing (*second revision*)
12666 : 1988	Methods for performance assessment of ultrasonic flaw detection equipment
13805 : 2004	General standard for qualification and certification of non-destructive testing personnel — Specification (*first revision*)

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 2417 shall apply, in addition to the following.

3.1 Bloom — A semi-finished forged, rolled or continuously cast product intended for re-rolling or forging. The cross-section is square or rectangular (excluding slab) and is generally more than 125 mm × 125 mm or equivalent cross-sectional area.

4 PERSONNEL

Personnel conducting examination shall be trained and certified as per IS 13805.

5 EQUIPMENT

5.1 Ultrasonic Apparatus

The apparatus shall conform to IS 12666 for performance assessment of ultrasonic flaw detection equipment.

5.2 Probe

A suitable probe having crystal diameter between 20 mm and 25 mm, and frequency in the range of 1 to 4 MHz shall be used.

6 CALIBRATION OF APPARATUS

6.1 DGS Calibration

Prior to use, verify that the DGS overlay matches the probe size and frequency. Accuracy of the overlay can be verified by reference blocks as described in IS 12666.

6.2 Select the appropriate DGS scale for the cross-sectional thickness of the test specimen to be examined. Insert the overlay over the CRT screen, ensuring the DGS scale base line coincides with the sweep line of the CRT screen.

6.3 Using sufficient couplant place the probe on the test specimen and by adjusting the gain (dB) produce the first backwall echo, clearly visible on the CRT screen scale.

6.4 Using time based adjustment shift the trace until the foot of the rising flank of the initial pulse is on the zero point of the scale and the backwall echo is on that scale value which corresponds to the thickness of the test specimen.

6.5 Using controls 'gain' (dB control) and 'continuous gain' adjust the back wall echo to the amplitude of the backwall echo curve within 2dB variation.

6.6 Using the 'gain (dB)', control increase the instrument gain by the dB value given for the back wall echo curve.

6.7 Instrument is now calibrated and flaw sizes that can

be reliably detected can be directly read from the CRT screen. These flaw sizes are the equivalent flat bottom reflector that can be used as a reference point.

6.8 In the absence of DGS scale appropriate distance-amplitude curve shall be developed.

6.8.1 The material used for reference blocks shall be free from defects. The material of reference block and the material to be tested shall have the same accoustic attenuation as far as practicable.

6.8.2 The reference standards shall be flat bottom holes drilled perpendicular to one of the end faces at the centre to a depth of about 25 mm as given in Table 1.

6.8.3 A distance amplitude set shall contain a number of reference blocks with identical hole sizes with varying distance from the entry surface to the flat bottom holes. The distance amplitude curves for different sizes of flat bottom holes having different distance will be drawn on the CRT screen by selecting a suitable gain. As the diameter of holes vary between 2 mm to 12 mm, sensitivity may be required to be changed, this should be taken care of while plotting the curves on the CRT screen.

6.8.4 As distance-amplitude correction (DAC) depends upon the equipment and probe used, it is to be established before proceeding with the test. As shown in Table 1, DACs shall be plotted for varying flat bottom holes (2 mm to 12 mm) at varying depths for different frequencies (for example 1-2 MHz separately).

6.8.5 All dimensions of interest like, depth of block, hole and diameter of hole shall be checked accurately to a tolerance indicated in Table 1.

6.8.6 For any change in setting of equipment, probe, couplant and operator, recalibration shall be carried out. Change in gain of more than 20 percent when confirmed at the end of test shall invalidate the test carried out and fresh test shall be carried out after recalibration of the equipment.

6.9 When testing on actual blooms after calibrating the instrument, transfer corrections should be made.

7 SURFACE CONDITION

The surface of the bloom shall be made free from loose scale, rust and such other extraneous matter as far as practicable. Heavier size bloom may have ragging mark on the surface of the rolls for increasing the angle of bite. Testing on such raised portion may not be possible. If testing on all area is required, prior agreement shall be made between the supplier and the purchaser for such test.

8 COUPLANT

Water, light or medium viscosity oil or grease shall be used as the coupling medium. If found necessary, other fluid may also be used.

9 MODE OF SCANNING

9.1 The blooms shall be tested on any two adjacent faces by moving the probe along a sinusoidal line from one end of the bloom to the other end so as to cover at least 10 percent of the surface area of the faces.

9.2 Whenever a flaw is detected during scanning, the entire surface area equivalent to cross-section of the bloom centred around the defect indicated shall be scanned.

9.3 Closer scanning than those specified in **9.1** and **9.2** can be carried out with mutual agreement between the purchaser and the supplier.

10 ACCEPTANCE STANDARD

10.1 Definition

10.1.1 *Core Zone* — Core zone is defined as the

Table 1 Dimension of Reference Blocks
(*Clauses* 6.8.2, 6.8.4 *and* 6.8.5)

Sl No.	Block Depth mm	Tolerance mm	Hole Dia mm	Tolerance mm	Depth of Hole mm	Tolerance mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	50	0.50	1.5-12	0.10	25	0.50
ii)	100	0.50	1.5-12	0.10	25	0.50
iii)	160	0.50	1.5-12	0.10	25	0.50
iv)	200	0.50	2-12	0.10	25	0.50
v)	250	1.00	2-12	0.10	25	0.50
vi)	300	1.00	2-12	0.10	25	0.50

central zone having diameter equal to one half of side of bloom.

10.1.2 *Remaining Area* — Area other than core zone.

10.1.3 *Half Value Length* — The length of the flaw as established by movement and plotting the mid-point of probe when the echo falls to 50 percent or 6 dB.

10.2 Acceptance Limits

10.2.1 Defect exceeding 1 mm equivalent flaw diameter or the minimum equivalent flaw diameter which can be detected taking into consideration the sound attenuation shall be recorded.

10.2.2 The acceptability criteria for the different dimension of the bloom shall be as per Tables 2 to 4 and **9.1** to **9.3**.

10.2.3 Flaw indication showing the presence of pipes and flakes shall not be accepted.

10.2.4 Total loss in back reflection without assignable cause like improper coupling, etc, shall not be acceptable.

10.2.5 With prior agreement any other acceptance criteria other than those specified from **10.2.1** to **10.2.4** can be followed, if specified and agreed to between the purchaser and the supplier.

11 TEST REPORTS

11.1 A test certificate shall indicate the size, grade of steel, cast number and ultrasonic acceptance grade, name of UT operator, his level, date of testing.

11.2 A suitable identification mark indicating the acceptance grade shall be given on the cross-section of the bloom.

Table 2 Criteria for Acceptability of Flaws in Blooms of >250 mm Up to 300 mm

(*Clause* 10.2.2)

Grade	Maximum Acceptable				Continuous, If Half Value Length Exceeds mm	Maximum Acceptable Flaw Length mm	Maximum Distance Between Flaws	Acceptable Number of Flaws per Metre Run	Acceptable No. of Flaw in Supp. Length of 3 to 4 m
	Individual Indications		Continuous Indications						
	Equivalent Flaw Dia, mm								
	Core	Remaining Area	Core	Remaining Area					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	6	3	3	2	40	90	60	3	8
2	7	5	5	3	40	100	60	3	8
3	9	5	5	3	40	120	80	3	8
4	12	6	6	4	50	150	100	6	10

Table 3 Criteria for Acceptability of Flaws in Bloom Size Range of 200 mm to 300 mm

(*Clause* 10.2.2)

Grade	Maximum Acceptable				Continuous, If Half Value Length Exceeds mm	Maximum Acceptable Flaw Length mm	Maximum Distance Between Flaws	Acceptable Number of Flaws per Metre Run	Acceptable No. of Flaw in Supp. Length of 3 to 4 m
	Individual Indications		Continuous Indications						
	Equivalent Flaw Dia, mm								
	Core	Remaining Area	Core	Remaining Area					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	5	3	3	2	30	80	60	3	6
2	6	3	3	2	40	90	60	3	8
3	7	4	4	2	40	100	60	3	8
4	9	5	5	3	40	120	80	3	8

Table 4 Criteria for Acceptability of Flaws in Blooms of 200 mm Square and Below

(*Clause* 10.2.2)

Grade	Maximum Acceptable				Continuous, If Half Value Length Exceeds mm	Maximum Acceptable Flaw Length mm	Maximum Distance Between Flaws	Acceptable Number of Flaws per Metre Run	Acceptable No. of Flaw in Supp. Length of 3 to 4 m
	Individual Indiactions		Continuous Indications						
	Equivalent Flaw Dia, mm								
	Core	Remaining Area	Core	Remaining Area					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	3	2	2	1.5	30	60	40	2	5
2	4	2	3	2	30	80	50	3	6
3	7	4	4	2	40	90	60	3	8
4	9	4	5	2	40	70	70	3	8

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This Indian Standard has been developed from Doc : No. MTD 21 (4607).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 01 31, 2323 33 75, 2323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	2323 76 17 2323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	2337 84 99, 2337 85 61 2337 86 26, 2337 91 20
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Printed at Prabhat Offset Press, New Delhi-2